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FRIDAY, FEBRUARY 6, 1920

CONTENTS

Botanical Achievement: PROFESSOR WILLIAM TRELEASE 121

The Biochemist on the Hospital Staff: DR. FREDERICK S. HAMMETT 131

Charles Buckman Goring: DR. J. ARTHUR HARRIS 133

Scientific Events:—
The Department of Scientific and Industrial Research of Great Britain; Natural Gas Conference; The Steinhart Aquarium; Resignation of Dean Baker of the New York State College of Forestry 134

Scientific Notes and News 136

University and Educational News 139

Discussion and Correspondence:—
Unreliable Experimental Methods of Determining the Toxicity of Alkali Salts: F. B. HEADLEY. *On High-Altitude Research:* DR. ROBERT H. GODDARD 140

Scientific Books:—
Crampton's Studies on the Variation, Distribution and Evolution of the Genus Partula: A. G. M. 142

Gravity and Aerostatic Pressure on Fast Ships and Airplanes: PROFESSOR ALEXANDER MCADIE 144

State Rewards for Medical Discoveries 145

Special Articles:—
A Pocono Brachiopod Fauna: DR. W. ARMSTRONG PRICE 146

The American Association for the Advancement of Science:—
Section F—Zoology: PROFESSOR H. V. NEAL 147

The Paleontological Society of America 148

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BOTANICAL ACHIEVEMENT[1]

TWENTY-FIVE years ago The Botanical Society of America imposed on me the task of preparing a presidential address. To-day I meet a similar obligation laid on me by the somewhat more democratized society which continues to bear that name.

For my subject then, I took botanical opportunity—moved, you may say, by the hopefulness of youth which looks forward and plans optimistically. To-day I wish to speak of botanical achievement—moved, you may say, by the observed tendency of age to live in the past. Possibly, later, you may not be sure that in choosing complementary subjects I have not wanted to extract much the same hopeful anticipatory lesson from both.

As one looks back over the past, he sometimes finds it difficult to pick out the significance of individual components of the conglomeration that forms the present superstructure of our science, and its foundations are buried in obscurity. Perhaps the most significant observation that he makes is that a person who is minded to add to it has each year to climb to a greater height before his own work can be commenced—unless he turn his attention to repairing the weaknesses and filling the crevices and pointing-up what has been done by others.

Work of this kind really makes the structure stronger, really keeps it from crumbling at some weak point under the weight that has been added above, and gives it an appearance of finish that must be secured at some time and by some one's labor before it can meet with final approval under critical inspection. Undertaking it may bring to light, even, wholly faulty workmanship or the incorporation of materials that have already begun to

[1] Address of retiring president of the Botanical Society of America, given at the Botanists' dinner, St. Louis, December 31, 1919.

disintegrate, and in this way may lead to replacements at various points and to reenforcement of the very foundations.

In putting up a building, such work is found to delay completion of the enterprise to a surprising extent after it seems to the casual observer to be about finished. Those who do it usually derive their satisfaction as workmen from knowing that they are accomplishing something necessary but which ought always to have been left as they leave it; or their esthetic sense is gratified in the pleasing finish that they give to what they found strong and serviceable but raw; or they know that they are safeguarding the completed structure against the inroads of time: but they do not see it really grow under their hands.

If we understand science to be systematized and formulated knowledge, we may be pardoned for stopping to wonder whether sometimes we may not fail fully to grasp the meaning conveyed by these words. Knowledge in a particular field may appear to be systematized and formulated in itself while it lacks comparable incorporation into the knowledge of other things. It may appear ideally dissociated from useful application: but perhaps it never is so in reality. Segregation of the arts which apply science in the practical affairs of life, perhaps does not really remove the necessity of considering all of these applications in the classification and formulation of that knowledge which science claims as its peculiar field.

The edict of an emperor, the injunction of a priest, the counsel of father to son, in the far-off days when civilization was establishing itself on the Tigris and the Ganges or in China, fails to come within our definition of science. We call such instruction empirical rules. But in doing so we can not fail to recognize that before Aristotle philosophized on the phenomena of life and Theophrastus formulated what he knew of plants—which we call the beginning of the science of botany, men had acquired knowledge in our special field and had classified it obviously to the extent of rejection of what they could not use and of selection of what they made the basis of an agricultural practise which may have been crude and inefficient as measured by the standards of to-day, but which was adequate to their needs and appears very refined in comparison with the earlier dependence for food upon the chase— either on land or water, or gleanings of roots and fruits from the plain, the mountain-side, or the forest. One hesitates, even, to think of these still more primitive practises as carried on independently of a very large amount of knowledge gathered and sifted and winnowed through many preceding generations as men worked their way toward an empirical precursor of what we now agree to call science.

When Liebig, the chemist, disposed of the humus theory of nutrition of ordinary plants he is considered to have been making a contribution to the science of botany. When Gilbert and Lawes in the field, and Winogradsky in the laboratory, put the completing link into the chain of the circulation of nitrogen as an active element, they are considered to have been making the same kind of contribution to the same science. I am wondering if my late and lamented associate Cyril Hopkins, calling himself an agronomist, has been far from the same field of science in teaching farmers in the great corn region of the world how to maintain for their children and their children's children a soil fertility that the first generation of white settlers imperiled, and if the last service of his life—carrying his message to those who now farm the worn-out lands of the Hellespont —must be excluded from the recognition that we accord to the achievements of science. If in considering its achievements I chance now and then to wander too far from standardized or forming definitions of our particular science, I trust that the lapses may be excused as evidence of unclear vision rather than wilful disregard of established boundaries.

The superstructure of botany, broadly defined, looks much the same to the casual observer as it did twenty-five years ago. It has been made more finished in parts, windows have been put in where there were blank walls, some parts have been pointed up or rebuilt, perhaps the gables have begun to take form

toward its final closing in; but a snapshot today from certain positions looks very like a snapshot taken a quarter-century ago except that what seemed then to be temporary lean-tos are beginning to look as if they belong where we see them or to give unmistakable signs of strengthening as well as amplifying the whole.

Perhaps this is the impression made on the superannuated workmen of a generation ago, and of some of those whose activities have continued from the earlier time up to the present. The idea of many who have come on to the job within the past two decades is very different. Under their own hands they have seen the shaping of the gables and the rising of the wings, and in their eyes these have given to the whole a very different appearance from what it presented when their work began. Indeed, under their guidance, and from viewpoints of their selection, it may scarcely look like the same edifice; and they may even point with pride to a well-finished and symmetrical annex in comparison with ragged parts of the main wall still defaced by temporary scaffolding.

The edifice of our science is less comparable with a modern warehouse like the great supply-base that the army constructed in nine months on the levee at New Orleans, than with a medieval chateau that has been changed from a feudal castle into a modernized home. The first is planned and constructed as a whole, and is consistent throughout. The other has existed through and developed with the centuries until most traces of its original plan—if there ever was one—have become obliterated.

Perhaps in this may be found explanation of an impatience that is manifested sometimes by botanists who do not like to see old symmetry changed, or by others who do not like to see labor wasted on walls that are no longer serviceable or to see these guarded from dismemberment so that their materials may be used for additions. Both kinds of criticism are likely to continue as long as construction continues. It may prove a misfortune for botany if either ceases, because the end of its usefulness will have come if it ever reach a stage in which it can no longer be changed with the changing times; but it will have become a ramshackle unserviceable monument if it ever reach a stage in which it has lost the unification of consistency in its details.

The achievements of botany have been like the achievements of nations in many respects, indeed like human achievements in the aggregate. It is impossible to trace its history without seeing some of the factors which have contributed to or retarded its advancement. Men and incentive have been necessary in the first place, opportunity in the second, and intelligent leadership in the third. Of these, perhaps, it may be said that "the first shall be last, and the last first," without too great deviation from the truth.

Men without leadership, even though they have opportunity and incentive, do not usually accomplish great things: and what unled men have achieved has resulted from their ability to plan for and lead themselves. They have been pioneers whose restless spirit has led them to spy out the land beyond the confines of the known. From the reports or echoes of their experiences has come knowledge that the limits of the knowable lay beyond the limits of the known as they found them; and their individual incursions have been followed ultimately by the invasion of numbers of men under the organization of leaders.

These are the true settlers: their leaders are the apostles of progress. Yet there rarely has been a time when an exodus or a hegira has been complete; and when it has, others less happily circumstanced have found in what was abandoned something to allure them from what they already possessed. Even good leadership, too, may have failed in adequate preliminary knowledge or planning, and more than once the new has proved inferior to the old or has been abandoned under wiser or better-informed guidance, or a generation and more of men have wandered in the wilderness before reaching the promised land; and lesser and transient migrations often have preceded or accompanied a large movement.

The founders of our science were pioneers rather than leaders: men with restless minds, no more satisfied with limitation of their field of action when they could see beyond its

arbitrary boundaries than some of us to-day are satisfied with an arbitrary zero-date for the scientific naming of plants when it is evident that scientific nomenclature began in part at a much earlier date.

Without the nature-philosophy of Aristotle there would have been no starting point for the systematization of Theophrastus. Yet without centuries of knowledge accumulated through human experience there would have been no background for either. They were the men who through systematization and coordination made the known understood, and thus opened knowable paths into what for them was the unknown.

It was a little incursion led, after a thousand and more years of mental vegetation, by a few nature-loving men of the Rhineland across the old boundaries. Though their day was that of revolt against theologically restricted thought, these resurrectors of a buried but not yet dead science were free-thinkers rather than protestants when they turned from canonized books to a real examination of nature. They were few in number and at first isolated in action; their excursions did not lead them far from home, but they were joined early by others, and their spirit found an instant echo in the sunny south. Instead of remaining explorers they became leaders of little bands whose small advances and retreats cleared the way for advance after advance of the usually better organized and at times better led army of searchers after the truth who in due time became known as botanists.

Small wonder if this growing army saw its legitimate opportunity less comprehensively and less clearly than we see it nearly five hundred years after the movement started! Without such pioneers, the science of botany might have remained to this day within the bounds that Theophrastus found to encompass it over two thousand years ago. Without other, later, even more venturesome pioneers, what they saw in it might remain to us as its present content.

Back of their activities was the incentive that underlay these, the unquenchable human thirst for knowledge. Through the following centuries this has operated side by side with the equally ineradicable human instinct for leaving well enough alone; and men have progressed dominated and restrained by the massive inertia of conservatism, but breaking free every now and then for a trial of the individual inertia of motion, much as a molecule of evaporating water passes off into freedom—ultimately to be lost in space, to enter into a new cycle, or to return to the bondage from which it made its escape, with far-reaching derangement in any case of the stability of what it left behind or joined.

Effort, when really effective, is purposeful. When the microscope provided means of seeing clearly what living beings consist of, it was not Hooke, who first published its revelations, but Malpighi and Grew, who shortly afterward examined the structure of living things with a view to understanding their vital processes, who laid the foundation for a broader science than their predecessors had conceived. They and their followers, in planning and building on the lines that we now recognize from long habit as being those that characterize botany, did not go far from the procedure that has distinguished successful human effort in general, in which a search after the true and the effective has shaped itself usually into a quest for proof or disproof of some theory of what is true or effective.

Without the guiding line of philosophy, the search might or might not have reached its goal. But with it, the result has depended upon adaptation of the means to the end—an adaptation which in our own day and in the last quarter-century has grown with surprising rapidity and extension of the experimental questioning of nature to which science turns with confidence for the solution of those problems that really lie within its field. Beyond that field still lies the realm of metaphysical speculation, which Lewes, half a century ago, protested against calling philosophy because in this sense he felt constrained to call the restless motion of philosophic speculation rotary in contrast with the linear (perhaps one would rather say dendritic) progress of science. The lure of the pioneer lies in the prospect of novel as well as great return. A few years ago some botanists were discussing

present-day opportunity in botany, and the opinion was voiced that it lies in the line of large and special equipment opening fields beyond the reach of the ordinary man. This may really be so. Certainly the first men to use the microscope were privileged beyond their fellows: but as we look back on their work they do not shine with a brilliancy corresponding to the greatness of this privilege. Rather, they profited by it to the extent of their knowledge and talent; made much or little progress according to their possession of these personal gifts; and have been surpassed by men who much after their day were impelled and instructed to look deeper and see further with the same instrument.

The optimism which led me twenty-five years ago to see hopeful opportunity for every man inspired by an all-compelling curious interest in nature and natural phenomena leads me still to see hopeful opportunity ahead of every such man—proportioned to his talent and under everyday environment rather than dependent on the special and novel provision which may fall to the lot of a fortunate individual here and there.

Botany, as a science, grew out of the gradually accumulated knowledge of plants acquired through using and cultivating them. The art of applying this knowledge really underlay the science into which it has been organized and formulated, though to-day it rests upon this, which constitutes a firm foundation in agriculture, medicine and the varied fermentation industries. That its scope should broaden, was as inevitable as that the natural horizon should amplify for a man climbing to a hilltop. That the mere selection of suitable subjects for microscopic study should result in closer observation of all that was looked at was equally natural. That Van Helmont's demonstration that plants are not built up out of earth should have preceded a separate analysis of all possible sources of their substance is self-evident. But discovery of the large part that the atmosphere plays in this organic synthesis, of the marvelous organism that a vegetable cell proves to be, and of the part played in heredity by some of the parts of this unit organism of organisms, is seen to have resulted more from the intelligent ingenious use of means at hand than from restricted privilege.

If one were to lapse into momentary pessimism in an optimistic review, the slip would come from recognition of the instinctive conservatism that inclines most of us to see only a form of some well known plant in a specimen that the inspired discoverer knows and even describes as hitherto unknown; or that leads us to ignore as "dirt" or artefacts the seemingly uncharacteristic parts of our preparations—as Löhnis believes that the most eminent bacteriologists have done; or that leads to a wish that experiments on living things were not so apt to turn out differently from the predicted result. We may destroy puzzling intermediates, throw away disappointing preparations, or exclude unsuccessful experiments from our calculations: but we do not explain them in doing this—we merely evade the truth that they mutely offer for our apprehension. It is the exceptional man who, even if he lay them aside for the time, as Haeckel, in his youth, did the "bad" species of his herbarium, can not rest until he understands them.

This is the true pioneer type, not content with what is believed to be the known nor satisfied with little excursions beyond its border, but boldly, in season and out of season, pushing out into the unknown. Such incursions, guided by the compass of correct methods and starting from the direction of acquired knowledge, have been, are and seem likely to continue to be, the epoch-making first moves in scientific progress.

Men who lead in such progress sometimes set off with general approval and good wishes. They follow the bent of their less enterprising fellows. Even rumors of their achievements are received at par and passed on at a premium. Fortunate, then, for science, if the log of their journey come back for verification, for our average human tendency is to believe what we want to believe, and those of us who do not travel to the pole care for little more than to be told that it has been reached by an enterprising explorer when we confidently expected such an explorer to get there.

Quite as often, the pioneers set off in a direction that is uninteresting to the rest of us. They go and come, and we hear with passing attention if at all what they have been doing.

Sometimes they do a good deal of talking about the inadequacy of what is accepted currently; they are regarded as heretics or at best as destructive critics. We complacently await the calamity that we believe them to court, and are incredulous if not really disappointed when they do not disappear for good but return and ask for an impartial examination of what they claim to have brought back.

Each of these types has been represented over and again in our science, which has profited by the good of each; and in the long run it can not suffer through the bad, because time inexorably eliminates this. But there have been quite enough instances of mistakes and delays and discouragements on the one hand, and of spurts of stimulated effort on the other, following the activities of men blessed with the gift of originality and at the same time favored or hampered by its human concomitant of radicalism or conservatism, of sanguine credulity or of phlegmatic incredulity.

Starting from isolated springs of impulse, progress has settled into a continuous flow of constantly increasing volume and rather fixed direction, over and over again, until a new touch of genius or a new revolt against the established order has opened new channels that have broadened and deepened with the years without causing the main course to run dry.

Sometimes change has come through the talent of coordination, as when Linnæus brought chaos into order in the arrangement of flowering plants, or Saccardo in laboriously assembling the fungi. Sometimes it has come from an attempt to dam the main channel as a means of diverting a part of the flow in a new direction, as when Schleiden fought the systematists. Sometimes broad epitomization has caused the change, as when Sachs revivified the science by giving it coherence as a whole. Sometimes an epoch-making improvement in technique is to be seen, as when Strasburger showed how the most transient inner processes of the dividing cell may be preserved for comparative study extending over months or years. Sometimes a device accurately recording for later study every phase of a passing physiological process has shown what was unseen before. Sometimes, and perhaps more often, the result has been achieved through the purposeful untiring straightforward work of a man possessed at once of the plodding industry of the laborer, the genius of the designer, and the perspicacity of the philosopher: such men were von Mohl, Hofmeister and De Bary.

Whatever its type, work that has left its mark indelibly on the science has been done by men endowed with an infectious enthusiasm. These men may have lived to see their own discoveries set aside as incomplete or even faulty, like Schleiden; or they may have discarded their own forceful convictions, like Sachs; or they may have known that in doing a serviceable work effectively, they were as effectively placing a barrier before the greater work that they foresaw ahead, as did Linnæus when he substituted an artificial key for the real taxonomy that he could not develop. But, however far it may have been from perfection, what these men did appealed to the understanding; what they said obtained a hearing; and, above all, their consuming interest was communicated to others and yet others. They proved leaders as well as workers.

The personnel of botany forms a roster of men sometimes working alone, unstimulated and without following, sometimes founding schools, sometimes following in the footprints of masters. The suggestive thought is that these masters for a considerable part have been self made: that their followers who have become masters have broken for themselves new paths; and that one and all they have been workers fitting their work on to that of others, systematizing all, and enlisting eager hands to do the work that they saw ahead waiting to be done. They may not always have had what we call a proper veneration for

the antique, or a good sense of perspective, but they have left their mark on the edifice.

Two somewhat paradoxical if not antithetic achievements in botany stand out conspicuously in the last quarter-century or so: increasing assimilation of the science itself with cognate sciences into the broader science of life—biology; and an increasing tendency for its own members, differentiating into organs, to segregate into offsets and strike root for themselves.

To-day we rarely hear any one talk of the food of plants being inorganic, and that of animals, organic; we hear, rather, of green plants as the food makers of the world. Even the word assimilation has fallen into disuse or become hyphenated as applied to this process. Digestion, metabolism, nutrition, have become subjects of parallel investigation in the two branches into which the tree of life has evolved.

The incipient stage of cell division, with qualitative bipartition in its somatic stages and qualitative segregation in the formation of gametes in all but the very lowermost of protista, has become so largely known as to make it hard to think of any bit of existing protoplasm as other than a fragment of one primordial protoplast, or to think of a protoplast of today as not genetically related to every other protoplast past or present.

The chemico-physical activities of plant and animal no longer claim attention as separate problems; absorption, selection and rejection of material, ionization, diffusion, osmosis—all have become biological rather than zoological or botanical questions, as they pertain to living things; but botanists are doing their full share toward answering them.

That botanical investigation should have demonstrated Mendel's law two generations ago or exhumed it two decades ago, places this discovery among the achievements of botany; but on it has been founded the biological superstructure of genetics—as valued an adjunct of the stockbreeder as of the breeder of plants. That a botanist differentiated between fluctuations and mutations and so simplified the understanding of natural selection has not prevented that differentiation penetrating into every branch of evolutionary investigation.

That toxins became known when the activities of bacteria were studied, has not prevented the student of animal physiology from carrying the same study of excreta into the relations of animal parasites and their hosts, or from developing from it the theory of autointoxication. Enzymes, hormones and vitamines—whatever either may be, now lie in the common field of biology, but some of the best work on them is done by botanists.

Out of the harmonies and disharmonies of plants with the manifold kinds of environment that the world offers, has developed a line of ecological observation, experimentation, and speculation that not only has brought the microscopic algæ of the world-plankton into recognition as the first fruits and the foundation of all aquatic life, past and present, but points as unmistakably to the individual birth, adolescence, mature life and senescence of a flora as the experience of agronomy does for a plant or recorded history does for a community of men: it has passed forever from the kodak-census stage.

Incursions into the no-man's-land confronting science are increasingly paralleling the phenomena that ecology deals with. The rapid invasion of an army of men, or a swarm of locusts such as I have seen blackening the sky in Central America, carries its own suggestion of impending conquest or devastation. The trickling of a thin thread of water through the dike, the exploration of a few pioneers or the settling of a few families beyond the front, may escape notice as significant; and the army may be driven back or the grasshoppers stopped by attention to their breeding places. The most-heralded advances sometimes prove the least important, and the humblest, the most significant, in retrospect.

Who but a croaking pessimist would have dreamed that an unknown fungus spore dropped on the Emerald Isle would lead to famine and starvation affecting a large population of men; that a rather uninteresting imperfect fungus added to the local flora of New York would cause the magnificent chest-

nut forest to disappear from our seaboard; that the cultivation of a water plant would choke the streams of England or render those of Florida unnavigable? The like is going on all of the time without such results, and even the man who knows speaks often to an unhearing audience when he ventures to proclaim that an immigrant can do what the leopard moth has done to the elms of New England or the boll-weevil to the sea-island cotton: but the lesson is being learned, bit by bit, and applied with quite as much zeal as wisdom.

In much this way, science has reached its achievements: sometimes annexing large fields that have proved less profitable than they were advertised to be; sometimes finding itself in possession of most fruitful territory that it did not know it was invading. That the mountains of conquest sometimes prove barren and the drained plains of slow sedimentation sometimes prove of inestimable productivity may well lead us to embark in future on the most lauded enterprise with reasonable caution, and to foster in every wise way the experimental prosecution of even the least obviously promising of minor undertakings.

Among newer lines of botanical activity none stand out with more significant distinctness than those directed toward getting conclusive demonstration of the active causes of organic variation and of organic function through a direct questioning of nature. To such experimentation, the shifting theory and complicated phenomena of physical chemistry are fundamental; to it, the deftest and best controlled manipulation is essential; to it, recognition and successive elimination of the many interwoven conditioning factors are indispensable. From it, the subtle change that converts living into dead matter is not capable of separation.

Biometry, laborious to the last degree, is the scale by which some of its results are to be made evident and coordinated. Biochemistry has taken assured place as one of its most necessary tools. Even the physical intricacies of behavior in colloids that never figure in vital phenomena are being pressed into daily use as furnishing analogies for if not demonstrations of the workings of that substance, protoplasm, which alone lives, alone responds to stimulus in the sense of the physiologist, and alone increases its substance through nutrition.

This entire line of advance is very new: some of its progress is startling: but its final results do not appear to promise to be those of metamorphosis but rather of cumulative mutations, perhaps mostly small. In it, above all other lines of progress, caution, conservatism and avoidance of too free generalization and haste in announcing and applying results appear to be desirable.

It is natural that a science concerning itself with the prime makers of human food—and for that matter of all food, and of the healing agents and poisons of the world, should have gleaned its very first results from the usefulness or noxiousness of the materials of its study, and that its achievements should have acquired great economic importance. Too much stress can not be laid on the fact that this is so, and within reason too much can not be expected from its future activities.

This science works within the bounds of what we still regard as natural law, and will continue to be so limited however these boundaries may be defined and extended. Nevertheless because of its discoveries the unpalatable has been made palatable and the unwholesome made wholesome in food; two blades of grass and two grains of wheat really have been made to grow where but one grew before; it has unraveled the mystery of the epidemic scourges of farm and barnyard, has pointed the way to prophylaxis and breeding of hardier races, and at the worst, has shown where therapy is futile. It certainly will make known and understood the critical periods in crop growth, and enable the agronomist to foster and protect his crops with profit at these periods; and it is not unlikely to enable the man who knows to judge and score the growing crop as the growing herd is judged and scored. It has founded a practise of self-sustaining fertility of the soil, and it points a way to restoration of impoverished soils.

These achievements have not come by leaps and bounds of either discovery or application:

they represent gradual accomplishment in both directions. Nevertheless such practical results have been reached within the memory of men now living—many of them indeed through men now with us. The methods of our science are analytical, its application is educational: both require time, and the applications of its teachings tend to pass its results from the questioning realm of science into the formulated empiricism of an art.

The world stress that we are passing through has caused attention to be turned, as never before, toward science; and science and its methods have received a utilitarian recognition never before accorded them. If botany and its dependent arts have met practical expectation as chemistry and physics and their dependent arts have, its hopeful activities are assured quantitatively and qualitatively for generations to come: if it has shown an inherent lack of the liability of these sciences, in which application is almost synchronous with discovery, an understanding of its slower but none-the-less certain methods will secure for it opportunity for equally honorable and useful future advance; and if we think it has been slow in response we must recognize that like the plants with which it deals it requires a period of tilth and growth between seeding and harvest.

Useful though it may be, until it shall have become a finished work, fit companion for those arts and achievements now kept from oblivion through the kind offices of the museum, it will be a sorry day for this or any other science when its prosecution proves to be dependent upon the evident and immediate usefulness of its discoveries.

When the inspiration of the greatest of modern botanists, Sachs, gave to botany something of the meaning that it now has, its place in the educational world changed. Though biological science from its more complex nature fails to give the promise of unmistakable and predictable answer to experiment that the physical sciences pledge and furnish, it took place quickly and without question as one of the foundation stones of the educational idea which recognizes experimentation and observation as of fundamental value in training the human mind.

Perhaps it was put to this use in the best possible way and for the best possible reasons. Its achievements for two generations show that large results have come because of or despite its incorporation into the curriculum of even the secondary schools: the methods of using it, at any rate, have been largely those believed best calculated to make investigators of the pupils who studied it.

To some people, it has seemed from the first that all who study a science can scarcely be expected to become specialists in it. There is no reason for surprise in the patent fact that few of the myriads of students of botany during the last half-century have become professional botanists: investigators are born rather than manufactured. There may be just ground even for a growing feeling that in its application to education, botany should appear in a different guise and with different accents from the same science as the investigator knows it.

If we are wise and alert who wish to see botany or even biology at large continue—as we all must believe that it should—an element of popular instruction, we must see that in the school it regains that simple understandable everyday relation with everyday life that its vastly simpler precursor possessed; that in the college its more complex present-day relations with life are made part of the equipment of all of those who are to teach it in the schools and to follow it into the university; and that in the university its study is characterized by a breadth of understanding and a scope of vision commensurate with that refined specialization which marks the successful delver after facts.

This is a suggestive gathering. It is a session of The Botanical Society of America, but there are present many members of the Phytopathological Society, of the American Society of Naturalists, of organizations of ecologists and geneticists, of fern students and of moss students. Such organizations are meeting in affiliation with the American Association for the Advancement of Science, and members of

the botanical and agricultural sections of that great Association are of our number. Pomologists and men devoting themselves broadly to horticultural science are with us. I should not be surprised if there were present also men who call themselves bacteriologists, foresters, or pharmacognosists, though the immediate affiliation of their special national societies has been shaped otherwise. We are here at the present moment as botanists, viewing botany from the various sides of its many specializations and applications. To-morrow we shall be pressing its subdivisions and segregations intensively in specialized sessions. Let us not forget when we do this that in union lies strength and that in division of labor lies efficiency; nor that efficiency usually reaches its maximum in the connected correlated organs of an organism, each taking and giving for the common good.

I would not urge the tyro among us to become less a cytologist, less a bryologist, less a physiologist, less a bio-chemist, than his greatest inspiration prompts: but I would urge him earnestly to be more a botanist, more a naturalist, more a disciple of a broad science which in strength and effectiveness and symmetry combines all that is good of its many and diversified component parts.

Horticulturists talk of graftage. They know that their art can produce more effective creatures than nature has evolved; but stock as well as scion is selected for its inherent worth, and both are essential to the whole that is built up from them.

The great world upheaval has severed many a scientific union that seemed destined to last interminably. Some of the disjointed parts may never reunite: some unquestionably require careful handling. It appears to be our plain and paramount duty now to see that, if worth it, the parts of the old tree be given a chance to establish themselves anew, either on their own roots or on a better footing—not thinking for a moment that the tree of science is limited in time or space or components, but remembering always the old maxim that the whole is equal to the sum of all its parts and greater than any of its parts.

Out of the world dismemberment has come opportunity for cooperative world reorganization and reconstruction which can be made more effective in science than anything that has preceded it. The opportunity is ours. If we make the most of it, we shall attain the greatest of the achievements of science. Even if we fail, we need not miss the lesson that accomplishment in our field is of necessity never final but proves always to be the opening of new fields, fresher and larger, to those who understand the real nature of achievement—out of which opportunity continually develops.

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THE BIOCHEMIST ON THE HOSPITAL STAFF

DURING the past few years there has been gradually evolving in the general mind, and particularly the medical mind, the idea that the chemist is actually something more than a druggist or a detector of arsenic. The present records of the efforts directed towards an elucidation of the reactions of the human organism in health and disease, along the lines of chemical investigation, are an achievement that by their very import, if not their voluminousness, have forcibly directed the attention of the medical profession to the possibility that here is a line of attack worthy of notice. The rapid progress being made is adding so much to the fundamental knowledge of how the organism carries on its activities, that the solution of the many problems being brought to light is most turbid in the minds of the chemical physician and he is turning to the biochemist for clarification. Scientific medicine to-day acknowledges the fundamental value of chemistry in the fight for the prevention and cure of disease; it recognizes now, as never before, the need of ascertaining the basic facts concerned in body reactions and that the satisfying of that need rests in the intensive application of biochemical methods to the study of the human organism. Outside of diabetes there is a general lack of definite information concerning the intricate processes going on, giving rise to, or accompanying pathological conditions, and there is opening up a larger opportunity for acquisition of this information through the open-hearted cooperation between physician and scientist that is now becoming evident.

In view of these facts and since there is an increasing number of hospitals that are coming to realize that the optimum treatment for their patients depends not only in having at hand the means of attaining all possible data, but also that the hospital should be the center for investigation, and are adding to their staffs men specially trained in biochemistry, it seems apropos to discuss briefly some of the points these new alliances are bringing up.

The average physician dumps all chemists into one class, leaving the biochemists undifferentiated, considers them analysts and mentally determines their status on the hospital staff as one a little lower than the plant engineer, but somewhat better than a nurse, although lacking even a nurse's conception of medicine.

Somewhere, though just where I do not recollect, I have read a discussion in which the distinction was drawn between the types of workers in chemistry. It was there brought out that whereas a chemist is always an analyst, an analyst need not necessarily be a chemist, since a chemist is inherently a thinker in chemistry. On the hospital staff it is the chemist that is needed and it is the chemical specialist, the biochemist, for just as in the medical profession there are specialists devoted to certain types of disorders, so have we of the chemical profession divided ourselves according as our inclinations and training have fitted us to pursue certain more or less well defined lines of endeavor. The efficient biochemist, however, must be not only well founded in information and ability to think in terms of all branches of chemistry, but he must also be familiarly acquainted with the principles of physics and general biology. This is merely the groundwork and foundation, on it there must be erected the superstructure of a knowledge of morphology, physiology, bacteriology, pathology and the phenomena of normal and disturbed body functions. Only one with such training can be of maximum service in the field of hospital activities. To a man so equipped the opportunities for usefulness are large, and the full utilization of his services can not but resut in benefit to patients and science.

The question of what and how much routine analytical work should be placed on the shoulders of the biochemist is one of importance, and by routine analytical work is meant the regular and systematic chemical examination of every hospital patient. Routine work, it is true, must and should be done, for from such analyses it is possible to follow the progress of disease and the response to treatment. Moreover, it is from the accumulated mass data carefully correlated that the conclusions can be drawn leading to the understanding of fundamentals, but routine blood and urine analyses can be made by any skilled technician while it requires the cooperative efforts of the clinician and the medically trained biochemist to interpret the results. Now the biochemist being primarily trained for and adapted to research should not have his time so taken up with routine that he can give but meager attention to the outlining and carrying on of investigations. In fact I do not believe that this work should be a part of the duties of the biochemist, except in so far as the results are directly applicable to a certain specific problem, but that it should be done by a technician, leaving the biochemist's time for the investigatory cooperation essential for progress.

The fundamental purpose of the hospital is the cure or relief of the patient, and it should be the aim of the biochemist as an integral part of the institution to plan his work to that end. He has two points of view that are synchronous as to ultimate effect but different in immediacy. The one line is intended to throw light on the present condition and progress of the patient under treatment; it is individual. Correlated with this is the group study of specific disturbance in various individuals with the aim of acquiring information as to the general processes occurring in the disorder. These are the immediate objects of study. In addition, he should have in mind and as an object of his attention investigations along the lines of basic phenomena not connected with any individual

or specific pathological condition, but more with the point of view of contributing information as to fundamental functioning. The immediate proposition looms the larger because it is the more pressing. But who will say which is the more important? Logical planning will result in such an intimate dove-tailing of both the immediate and the basic lines of effort that the perspective of time will afford a well founded understanding of the causes contributing to disease, which understanding will lay the path for cure and prevention.

This can not be done nor can full development be obtained without a close cooperation of the other members of the hospital staff with the biochemist. And it almost goes without saying that this cooperation can not be effected unless the biochemist is equipped to understand the point of view of the clinician and is capable of giving to the clinician assistance in the working out of his problems. Progress can not be expected when the biochemist either by preference, or lack of opportunity to do otherwise, remains cooped up with his test-tubes and beakers knowing nothing of the patients save as numbered bottles of urine on which he makes his little tests. Consultations should be held at which the general outlines and progress of investigation should be discussed and opportunity afforded for the examination of any particular case necessitating a biochemical interpretation or study.

Complete independence should be allowed the biochemist in the outlining of his methods of procedure and the problems for investigation, always, however, seeking assistance and ready to give help when his specialized training fits him to be of service. His administrative duties should be confined to his own lines of activity and general laboratory supervision or directorship since it is in that field his capabilities have been developed. The instruction of nurses in the principles of physiological chemistry by the biochemist should be encouraged since the proper collection of specimens depends upon their intelligence. They can not be expected to have an appreciation of the precautions necessary in collecting the material if they are set to do it as automatons and with no knowledge of the purposes involved.

In these days of ours the question of compensation is extraordinarily vital. The scientific specialist is such because he can not help it. His mental make-up forces him to spend his life in giving, not in getting. He is rarely a success in self-directed commercial enterprise. He has no inclination to enter such work unless driven by necessity, and then it is with repugnance, that he competes with his fellow-men in the accumulation of dollars. Rather does he live a life largely deprived of the creature comforts accorded those mentalities whose urge is acquisitional. But whose is the greater service is obvious. Why should not such workers be given compensation sufficient to allow them to have homes and more than bare necessities? Why should they be forced to derive their major joie de vivre in intellectual introspection? Is it because the work is of low value or is it because of sluggish appreciation and lack of self-advertising? Whatever the causes it is not right, but no matter how wrong it is we have men, and will continue to have men who will gladly devote themselves to science whatever the compensation. Nevertheless measures should be taken by properly organized associations, to so educate those necessary of education that future generations of scientists, if not this one, may receive an adequate income in recognition of their continued contributions to human welfare.

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CHARLES BUCKMAN GORING

FEW of the readers of SCIENCE will be familiar with even the name of Charles Goring.[1] His time was largely spent as a

[1] Goring was born in 1870 and died in 1919. He was a student and later a fellow of University College, London. He served on a hospital ship during the Boer War. At the time of his death—met at his post combating the influenza epidemic—he was Medical Officer in Chief at Strangeways

prison medical officer. His one monumental work, which may perhaps best be described as *the biology of the convict,* is still unfamiliar to all but a limited circle.

Goring's work[2] was based on thousands of data and is stringently biometric in form, but he was no mere measurer, card shuffler and constant computer. He knew his convicts as the trained student of animal behavior knows his organisms—and better, for he had not merely their physical measurements and an intimate personal knowledge and evaluation of their mental characteristics but knew much of their ancestry and family associations. To Goring, measurements were inviolate—not to be juggled with, modified or discarded because they did not substantiate a popular theory. Better proof of this could not be found than the fact that the raw data for his book were set up before the calculations were well under way. Goring as a thoroughgoing biometrician believed that in many fields of research valid conclusions must rest upon the mathematical analysis of large masses of data. But in his research each constant was critically weighed against his own broad and intimate personal experience of the individual instances which constitute the mass.

I find it difficult to decide just what characteristic of Goring impressed me most when we were working together at the Biometric Laboratory ten years ago. Sometimes it was the steadfast scientific purpose which had supported the years of painstaking detail upon which his great book rests—detail scrupulously executed notwithstanding the fact that there was at times little prospect of its ever serving as a basis for constants and generalizations. Sometimes it was the breadth of interests, knowledge and sympathies of one whose work lay in a field seemingly so circumscribed. Sometimes it was the entire freedom from both callousness and sentimentality of a man who had spent a decade, more or less, with the inmates of the British prisons.

One sentence tells much of the man. One day I asked, "Why is this to be *The English Convict* instead of *The English Criminal?*" He replied instantly, "Perhaps some of them are not criminals, only convicts."

J. Arthur Harris

Prison, Manchester. Those who desire may find a portrait and a more adequate appreciation in *Biometrika,* Vol. XII., pp. 297–307, pl. 1, 1919.

[2] Goring, C. B., "The English Convict; A Statistical Study." 444 pp. London, 1913. Abridged edition, Wyman and Co., 1915. The statistical work on this volume was carried out at the Biometric Laboratory with the cooperation of H. E. Soper and with the helpful suggestion and criticism of Professor Pearson.

SCIENTIFIC EVENTS

THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH OF GREAT BRITAIN

The following is a list of research associations which have been approved by the department as complying with the conditions laid down in the government scheme for the encouragement of industrial research and have received licenses from the Board of Trade under Section 20 of the Companies' (Consolidated) Act of 1908:

British Boot, Shoe and Allied Trades Research Association,
Technical School, Abington Square, Northampton.
Secretary—Mr. John Blakeman, M.A., M.Sc.

British Cotton Industry Research Association,
108, Deansgate, Manchester.
Secretary—Miss B. Thomas.

British Empire Sugar Research Association,
Evelyn House, 62, Oxford Street, London, W.1.
Secretary—Mr. W. H. Giffard.

British Iron Manufacturers Research Association,
Atlantic Chambers, Brazennose Street, Manchester.
Secretary—Mr. H. S. Knowles.

British Motor and Allied Manufacturers Research Association,
39, St. James's Street, London, S.W.1.
Secretary—Mr. Horace Wyatt.

British Photographic Research Association,
Sicilian House, Southampton Row, London, W.C.1.
Secretary—Mr. Arthur C. Brookes.

British Portland Cement Research Association,
6, Lloyd's Avenue, London, E.C.3.
Secretary—Mr. S. G. S. Panisset, A.C.G.I., F.C.S.

British Research Association for the Woollen and Worsted Industries,
Bond Place Chambers, Leeds.
Secretary—Mr. Arnold Frobisher, B.Sc.

British Scientific Instrument Research Association,
26, Russell Square, W.C.1.
Secretary—Mr. J. W. Williamson, B.Sc.

British Rubber and Tyre Manufacturers Research Association,
c/o Messrs. W. B. Peat & Co., 11, Ironmonger Lane, E.C.2.

The Linen Industry Research Association,
3, Bedford Street, Belfast.
Secretary—Miss M. K. E. Allen.

Glass Research Association,
7, Seamore Place, W.1.
Secretary—Mr. E. Quine, B.Sc.

British Cocoa, Chocolate, Sugar Confectionery, and Jam Trades Research Association,
9, Queen Street Place, E.C.4.
Secretary—Mr. R. M. Leonard.

Schemes for the establishment of Research Associations in the following industries have reached an advanced state of development.

RESEARCH ASSOCIATIONS APPROVED BY THE DEPARTMENT BUT NOT YET LICENSED BY THE BOARD OF TRADE

British Music Industries Research Association.

British Refractory Materials Research Association.

British Non-Ferrous Metals Research Association.

Scottish Shale Oil Research Association.

PROPOSED RESEARCH ASSOCIATIONS WHOSE MEMORANDUM AND ARTICLES OF ASSOCIATION ARE UNDER CONIDERATION

British Launderers Research Association.

British Electrical and Allied Industries Research Association.

British Aircraft Research Association.

INDUSTRIES ORGANIZATIONS ENGAGED IN PREPARING MEMORANDUM AND ARTICLES OF ASSOCIATION

Silk Manufacturers.

Leather Trades.

Master Bakers and Confectioners.

In addition to the industries included above, certain others are engaged in the preliminary consideration for forming Research Associations.

NATURAL GAS CONFERENCE

SECRETARY LANE, of the Department of the Interior, announces that the following appointments have been made for the committee of ten authorized by the resolution at the Natural Gas Conference, held under Secretary Lane's invitation at Washington, January 15, 1920: Van H. Manning, director, Bureau of Mines, chairman; John B. Corrin, The Reserve Gas Company, Pittsburgh, Pennsylvania; L. B. Denning, The Ohio Fuel Company, Pittsburgh, Pennsylvania; J. C. McDowell, Witchita Natural Gas Company, Pittsburgh, Pennsylvania; W. L. McCloy, The Philadelphia Company, Pittsburgh, Pennsylvania; John S. Rilling, Public Service Commission of Pennsylvania, Harrisburg, Pennsylvania; Miss Edna N. White, American Home Economics Association, Detroit, Michigan; Art L. Walker, Chairman, Corporation Committee, Oklahoma City Oklahoma; F. W. Wozencraft, Mayor, Dallas, Texas; Samuel S. Wyer, Consulting National Gas Engineer, Columbus, Ohio; and Dr. I. C. White, state geologist of West Virginia, Morgantown, West Virginia.

The functions of this committee will be to consider the wastes now going on in natural gas and the relations between the natural gas companies and the consuming public. The committee has been carefully selected from a number of nominations with a view to representing equally the interests of the public and the natural gas companies. Dr. Manning writes:

> The development and utilization of the most ideal fuel known to man—natural gas—has been accompanied by almost inconceivable wastes. Although these wastes have been greatly reduced during recent years, they have by no means been eliminated and the country to-day is paying the penalty of its sins by the depletion and even exhaustion of many of the formerly prolific gas supplies. These wastes have occurred in the fields where the gas is produced; in the lines through which the gas is transported; and from the cooking stoves, furnaces, boiler plants, etc., where the gas is ultimately consumed.

Through the knowledge and experience which has been gained in the natural gas industry, it is now known how these wastes can be practically eliminated, but the main obstacles now to be overcome before these economies can be put into effect are economic rather than technical; that is modern engineering can control these wastes, but it is necessary that the saving be made worth while. There must be a thorough consideration of the broad, underlying economics of the gas business and its relations to the conservation and better utilization of natural gas. There is a necessity that the public more thoroughly understand the economics and technique of the gas business to the end that machinery be devised and put into operation whereby the interests of the public and the gas companies can be brought together in such a manner that the gas now being wasted can be saved and used.

It is the purpose of this committee to consider these broader questions of the relations between the consuming public and the gas companies, that a program may be drawn up looking forward to the application of those engineering principles which it is known minimize the waste of natural gas now taking place and prolong the supply of gas to the consumer.

THE STEINHART AQUARIUM

The erection of an up-to-date aquarium in Golden Gate Park, San Francisco, is an event of some significance in the scientific world and the fact that it is to be under the direction and management of the California Academy of Sciences and supervised by Dr. Barton Warren Evermann, the ichthyologist, will insure it fulfilling its purpose of quickening interest in the fauna of the Pacific Ocean and the inland waters of the Pacific coast area.

Funds for the building of the aquarium amounting to $250,000 have been provided through the munificence of the late Ignatz Steinhart who stipulated in his will that the management should vest in the California Academy of Sciences. By an amendment to the city charter the city of San Francisco has undertaken the maintenance of the aquarium. The aquarium will be built adjoining the Academy's Museum building and will be equipped with a full complement of glass exhibition tanks. Outdoor pools for the exhibition of aquatic mammals form an essential part of the building scheme.

Dr. Evermann is now in the East and will visit the aquariums of Boston, New York, Detroit, Philadelphia and Washington to study carefully the most approved methods of installation.

RESIGNATION OF DEAN BAKER OF THE NEW YORK STATE COLLEGE OF FORESTRY

An appeal for better salaries for educators, particularly those in New York State and in the New York State College of Forestry, at Syracuse marks the letter of resignation filed by Dean Hugh P. Baker, who has resigned after eight years of service, to accept twice the salary he is rated as receiving at the State College of Forestry, by becoming secretary of the American Paper and Pulp Association.

Although he receives a big increase in pay, his letter of retirement specifies that the inducement which caused him to leave the College of Forestry was not the salary, but the opportunity to carry the profession of forestry into a great industry, that of paper manufacturing. His letter discloses that last year he refused an offer of $7,500 to enter a business career, but that the trustees increased his salary from $5,000 to $6,000 to remain, and he declined the offer. Owing to the rigidity of the New York state budget system, however, even this raise would not take effect until July, 1920, and only then if approved by the legislature. In his letter of resignation, he says this of the salaries of teachers: "The public is apathetic, to say the least, as to the needs of education, with the result that our public schools and colleges and universities throughout the country are suffering for the lack of the right kind of men and women in the teaching profession."

Dean Baker's last work at the College of Forestry will include an effort to secure adequate salaries for the educators in the college, some of whom are paid smaller than men in the same relative positions at other state educational institutions.

SCIENTIFIC NOTES AND NEWS

Dr. David F. Houston, formerly president of Washington University, secretary of agriculture, has been nominated by President Wil-

son to succeed Senator Carter Glass as secretary of the treasury. E. T. Meredith, of Iowa, publisher of *Successful Farming*, a director of the Chicago Federal Reserve Bank and democratic candidate for senator from Iowa in 1914, will succeed Mr. Houston as secretary of agriculture.

DR. HUGH S. CUMMINGS, of Hampton, Va., has been selected to succeed Dr. Rupert Blue as surgeon general of the Public Health Service. General Blue has served two terms as surgeon general. He was first appointed during the administration of President Taft and was reappointed by President Wilson. Dr. Blue will remain in the Public Health Service engaged in research work.

DR. HERMAN M. BIGGS, New York state commissioner of health, was reappointed by the governor for a term of six years, on January 12, and the appointment was unanimously confirmed by the senate on the same day.

PROFESSOR GRAHAM LUSK, of the Cornell University Medical College, has been elected associate member of the Société Royale des Sciences Médicales et Naturelles de Bruxelles.

DR. W. F. RUDD, of the department of chemistry of the Medical College of Virginia, Richmond, has been elected president of the American Conference of Pharmaceutical Faculties.

THE council of the Geological Society of London has made the following awards: Wollaston medal to Professor Baron Gerard Jakob de Geer (Stockholm); Murchison medal to Mrs. (Dr.) E. M. Shakespear; Lyell medal to Mr. E. Greenly; Wollaston fund to Mr. W. B. R. King; Murchison fund to Dr. D. Woolacott, and Lyell fund to Dr. J. D. Falconer and Mr. E. S. Pinfold.

AT the recent meeting of the American Psychological Association at Harvard University, a committee was appointed to formulate standards for the qualifications and certification of practising psychologists for the United States. The committee consists of Professor Bird T. Baldwin, State University of Iowa, chairman; Professor Walter F. Dearborn, Harvard University; Professor Leta S. Hollingworth, Columbia University; Dr. Helen T. Wooley, Vocational Bureau, Cincinnati, and Dr. Beardsley Ruml, The Scott Company, Philadelphia. State departments of education contemplating the certification of psychologists should consult with a member of the committee. New York, Wisconsin, New Jersey and California recently legalized practising psychologists.

PROFESSOR HEBER W. YOUNGKEN, head of the department of botany and pharmacognosy of the Philadelphia College of Pharmacy, has accepted the invitation of the board of control of *Botanical Abstracts* to become editor for the section of pharmaceutical botany and pharmacognosy of this journal.

DR. R. E. RINDFUSZ, formerly an assistant in the chemistry department of Oberlin College, is now chief chemist in charge of research for the American Writing Paper Co., Holyoke, Mass.

PROFESSOR THOMAS L. HANKINSON has been named ichthyologist of the Roosevelt Wild Life Experiment Station of the New York State College of Forestry, at Syracuse University. For the past seventeen years Professor Hankinson has been engaged in the study of fish in Michigan and Illinois, and for five years has been cooperating with Dr. Adams in the study of the fish in Oneida Lake and the Palisades Interstate Park region; since 1902 he has been teaching biological sciences in the Eastern Illinois Normal School, Charleston, Illinois.

WORD has been received that the well-known Swedish geologist, Professor Gerard De Geer, of Stockholm, expects to visit America in the autumn of 1920, in order to study the glacial geology in the northeastern part of the United States and Canada.

DR. WILFRED H. OSGOOD, of the Field Museum of Natural History, accompanied by M. H. B. Conover, of Chicago, sailed January 28 for Venezuela where they will make general zoological collections and distributional studies in the Maracaibo Basin and the Sierra de Merida.

IN the latter part of October, 1919, Carl D. La Rue, botanist for the Hollandsch-Amerikaansche Plantage Maatschappij, re-

turned to the laboratory at Kisaran, Asahan, Sumatra, after a five-weeks stay in Java, where he represented the research department of his company at the First Scientific Congress of the Netherlands East Indies, and at the First Technical Meeting of the Personnel of the Experiment Stations for the Rubber Culture.

We learn from *Nature* that Mr. Willoughby Lowe has recently started on a mission to the west coast of Africa for the purpose of collecting specimens for the South Kensington Natural History Museum. Captain Hubert Lynes, R.N., has just left England on an expedition to Darfur, where he intends to make a special survey of the avifauna of the Jeb-Maria Mountains for the bird department.

Mr. D. Franklin Fisher, formerly connected with the Bureau of Chemistry, U. S. Department of Agriculture, New York, N. Y., in the capacity of food and drug inspector, has recently resigned from that position to become research chemist in the laboratories of the Van Camp Packing Co., Indianapolis, Ind.

The annual Darwin Lecture at New York University will be given on Friday, February 13, at 4 P.M., in the auditorium at University Heights by Robert Cushman Murphy, curator of natural science at the Brooklyn Museum. Mr. Murphy sailed for Peru last August to conduct the Brooklyn Museum Peruvian Littoral Expedition. He has made a comprehensive study of the avian marine fauna of the Humboldt Current and of the Coastal Islands. He has been successful in taking hundreds of pictures—still and moving—of birds and other animals.

Dr. Wil'iam J. Humphreys, of the U. S. Weather Bureau, gave the address of the retiring president before the Philosophical Society of Washington on January 31, on "A bundle of meteorological paradoxes."

Dr. S. W. Stratton delivered an address on the "Advantages of the general adoption of the metric system in Easton, Pa.," on January 16, under the auspices of the Lehigh Valley Section of the American Metric Association. Under the same auspices Dr. Harrison E. Howe lectured on December 12, on the work of the National Research Council.

On the alumni lectureship in chemistry, Oberlin College has had Colonel W. D. Bancroft, chairman of the division of chemistry, National Research Council, lecturing on "Colloid chemistry," and Mr. Marsh, of the Hercules Powder Co., lecturing on "High explosives."

At the meeting of the Royal Society on February 5, by the council, the program consisted of a discussion on "The theory of relativity," opened by Mr. Jeans and continued by Professor Eddington, the Astronomer Royal, and others.

We learn from *Nature* that active steps are now being taken in the government to establish a memorial to Lord Lister in Edinburgh. The university and the Royal Colleges of Physicians and Surgeons in Edinburgh, under the control of which the memorial will be established, have determined to provide an institute for research and teaching in medicine. A site has been secured, and a committee is now being formed to make an appeal to the public for a sum of £250,000. Mr. Balfour, chancellor of the university will be president of the committee.

There has been established at Case School of Applied Science, in memory of the late Professor Sabine, of Harvard University, the Wallace Clement Sabine Research Fellowship in Acoustics. Its purpose is the encouragement of investigation in the science of acoustics. The holder of the fellowship will pursue his studies and carry on original investigation under the direction of Professor Dayton C. Miller. The facilities afforded by his laboratory for research in any part of acoustics are unusual, and this is particularly true as regards the analysis and synthesis of sound. A candidate for this fellowship must be a college graduate and should have had at least one year of advanced study in physics. The stipend is $1,000 a year.

Rear Admiral John Elliott Pillsbury, U. S. N., retired, president of the National Geographical Society, distinguished for his con-

tributions to science, especially on the Gulf Stream, as well as for his services as an officer in the navy, has died at the age of seventy-three years.

RICHARD BLISS, who died at Newport on January 7, was at one time an assistant in the Museum of Comparative Zoology, Cambridge, and bibliographer of the United States Geological Survey and the Northern Trans-continental Survey. For thirty-one years, until his retirement in 1914, he was librarian of the Redwood Library at Newport.

DR. S. MACKAY, professor of chemistry at Dalhousie University since 1896, died from pneumonia in Halifax, N. S., on January 6. Dr. Mackay was born in Nova Scotia in 1864. He was educated at Dalhousie and the Johns Hopkins Universities.

THE Senate has passed a joint resolution appropriating $500,000 to be used by the Public Health Service in combating influenza. The resolution directs the Public Health Service to investigate influenza and allied diseases in order to discover their causes and prevent their spread. It requires the allotment of money to universities, colleges and other research institutions for scientific investigation. The Public Health Service is accorded the privilege of making selection of such institutions.

A MEETING of surgeons, representing the surgical staffs of all the great teaching hospitals of Britain, assembled in the theater of the Royal College of Surgeons of England on January 8, as we learn from *Nature*, under the chairmanship of Sir Rickman J. Godlee, and resolved to form an "Association of Surgeons of Great Britain and Ireland." British surgeons have thus followed the precedent set by their colleagues the physicians, who formed a similar association a number of years ago. The object of the newly formed association is to permit surgeons as the staffs of the hospitals to meet together from time to time at various centers in order to exchange observations and compare results. The association will stand as the representative body for British surgeons, and in that capacity will represent British interests at international surgical congresses. Sir John Bland-Sutton was elected president of the new association.

THERE has been formed recently in Chicago a Scientific Laboratory Workers' Union, No. 16,986, American Federation of Labor. This includes fifteen members, physicians, chemists and bacteriologists of the Bureau of Laboratories of the Chicago Department of Health.

AT the annual general meeting of the Inventors Union, held in London, the provisions of the Patents and Designs Bill were warmly discussed in view of the inadequate protection the bill provides to British inventors. A resolution was carried to the effect that the government should be approached to consider the creation of an all-empire patent to replace the present system which entailed an initial outlay of several hundred pounds to secure protection in Great Britain and the dominions and colonies for the simplest invention.

UNIVERSITY AND EDUCATIONAL NEWS

THE corporation of Yale University having requested Dr. Fred T. Murphy to make a survey and report as to the school of medicine and Dr. Murphy having presented his views and recommendations, the committee on educational policy unanimously recommended the following minutes which were adopted by the corporation:

1. That there is a clear and definite opportunity and obligation of the university to medical education.

2. That the Yale School of Medicine has a valuable nucleus of men and material and sound traditions, which richly justify the development of an institution for medical education of the highest type.

3. That the corporation accept as a policy the development of a medical school of the highest type to include the pre-clinical and clinical years of instruction upon such principles of medical education as may be approved by the corporation, after conference with the medical faculty.

4. That every effort be made to obtain at the earliest possible date the necessary funds with which to expand and develop the buildings, the

equipment, the instruction, and the research, and the service, in accordance with the best ideals of modern medical education—as an essential unit of our university plan for development.

Professor W. H. Dalrymple has resigned the editorship of the *Journal* of the American Veterinary Association because of his appointment to the deanship of the college of agriculture of the Louisiana State University. The nominees for the governorship and the legislature have pledged themselves the support of the movement for a greater university, in which movement it is proposed to raise three million dollars for the college of agriculture.

Dr. Allen E. Stern, of the department of chemistry at the University of Illinois, took charge of the division of physical chemistry at the University of West Virginia, beginning in February.

Dr. Henry C. Tracy, of the Marquette Medical School, has been appointed professor of anatomy at the University of Kansas.

Dr. C. H. Edmundson, professor of zoology at the University of Oregon, resigned at the close of the fall term to accept the position as head of the department of zoology and director of the research laboratories at the College of Hawaii, Honolulu.

Professor Clarence Moore has resigned the chair of biology in Dalhousie University, Halifax, N. S., and has been succeeded by Professor Dowell Young, of Cornell University.

DISCUSSION AND CORRESPONDENCE

UNRELIABLE EXPERIMENTAL METHODS OF DETERMINING THE TOXICITY OF ALKALI SALTS

A method frequently used by investigators of the toxicity of alkali salts is to add certain percentages of salts to soils, plant them to crops and estimate the toxicity by the depression of the crop growth. They assume that if sodium carbonate or other salt is added to a pot of soil, that it remains in solution in the soil and that its toxicity can be measured by subsequent crop growth. Very elaborate and expensive experiments have been performed based upon this assumption.

Now it has been shown by various investigators that soils absorb a part, at least, of the salts added, and that the crop growth in these treated soils is much more closely related to the proportion of alkali salts recoverable from the soils than to the proportion of salts which have been added. In other words, the toxicity of salts is not so accurately measured by the amount added to the soil as by the salts recoverable by analysis after the treatments have been made.

Two papers have been published in the *Journal of Agricultural Research* which illustrate the erroneous conclusions that may be reached when toxicity is determined by the per cent. of salts added, viz., "Effect of alkali salts in soils on the germination and growth of crops," by Frank S. Harris, and "Soil factors affecting the toxicity of alkali," by F. S. Harris and D. W. Pittman. In both these investigations the attempt was made to measure the toxicity by correlating crop growth with the amount of salts added. In the first-named paper Mr. Harris reaches the following conclusions which are not in accordance with results obtained by other investigators. The questionable results quoted below would almost certainly not have been secured had the more accurate method been followed of measuring toxicity by correlating crop growth with the soluble salts found in the soil after the various additions had been made.

The conclusions which appear to the writer to be unjustified are:

1. "Only about half as much alkali is required to prohibit the growth of crops in sand as in loam."

Since no analyses were made Mr. Harris did not know how much alkali was contained in the soil solution in either sand or loam and the conclusion is therefore unjustifiable.

2. "Results obtained in solution cultures for the toxicity of alkali salts do not always hold when salts are applied to the soil."

This statement may be true but his experiments do not warrant the drawing of such a conclusion for here again the author did not determine the concentrations of the soil solutions and he therefore has no basis for comparing the toxicity of salts in solution cul-

tures with the same concentrations in soil solutions.

3. "The toxicity of soluble salts in the soil was found to be in the following order: sodium chlorid, calcium chlorid, potassium chlorid, sodium nitrate, magnesium chlorid, potassium nitrate, magnesium nitrate, sodium carbonate, potassium carbonate, sodium sulfate, potassium sulfate, and magnesium sulfate."

Since the author did no determine and did not know how much of these salts were actually in the soil solution he could not very well indicate their relative toxicities. It will be noted that sodium carbonate is placed near the bottom of the list as a relatively harmless salt, whereas, as a matter of fact, it is one of the most toxic salts occurring in the alkali soils of the west.

4. "Land containing more than the following percentages of soluble salts are probably not suited without reclamation to produce ordinary crops: In loam, chlorids 0.3 per cent.; nitrates, 0.4 per cent.; carbonates, 0.5 per cent.; sulfates, above 1.0 per cent. In coarse sands, chlorids, 0.2 per cent.; nitrates, 0.3 per cent; carbonates, 0.3 per cent. and sulfates, 0.6 per cent."

Here again the author draws conclusions without having accurate data on which to base them. If the above percentages were to be adopted by chemists in determining the suitability of alkali soils in the field for crop growth, the results would be misleading in the extreme. The results are not in accord with those obtained by determining toxic limits in field studies, nor with laboratory experiments in which toxicity is related to the alkali actually in the soil solution instead of to that which was put in.

In the paper by Harris and Pittman, published in November, 1918, the authors have adopted the same erroneous method but they are more careful in drawing conclusions as the absorption of the salts added is apparently recognized but is not determined and related to crop growth. The conclusion, however, that "Loam soils and soils with a high water-holding capacity may be successfully farmed at a higher alkali content than others" may possibly be true but there is no data given in the paper which justifies the conclusion, for the per cent, of alkali salts recoverable from the two kinds of soil was not correlated with crop growth.

It is also suggested that the results obtained by Brown and Hitchcock published under the title "The effects of alkali salts on nitrification" (*Soil Science,* Vol. IV., No. 3) and by Singh on the "Toxicity of alkali salts" (*Soil Science,* Vol. IV., No. 6) would have been more valuable had they been correlated with the recoverable salts rather than with the salts added to the soils with which they were working.

F. B. HEADLEY

NEWLANDS EXPERIMENT FARM,
FALLON, NEVADA

ON HIGH-ALTITUDE RESEARCH

I AM beginning to appreciate the difficulty of making one's self understood in a statement where matters are suggested rather than explained in detail, and where a critical attitude is urged until a result is actually verified by experiment, even when one feels perfectly confident beforehand what the result will be. The present statement is written for the purpose of correcting any misconceptions that may have arisen from my recent press statement.

First, the time necessary for a preliminary exploration of the atmosphere will be required chiefly for the preparation. It is not like an exploration of "darkest Africa," for, with the proper rocket apparatus and instruments, each flight will occupy but a short time; and not many will be needed to obtain a very considerable amount of information, such as an accurate knowledge of densities, that would be needed for any further developments.

The expense also will be chiefly that for preparation; namely, for machine construction and tests. A final form of apparatus, designed for reaching any particular altitude, should not be expensive. This is, of course, true of any product that requires machine development.

Incidentally, the object of these experiments is by no means restricted to the taking of photographs in the earth's atmosphere, although this application may have more uses than were at first suspected.

Regarding the ultimate developments of the method, I do not wish to leave the impression that these will be restricted to researches in or near the earth's atmosphere. On the contrary, every one of the matters so far proposed is, as I have already maintained, based upon sound physical principles, and can therefore be realized. Further, there are additional principles, the application of which is certain to lead to results of even greater interest and importance. All these results will be realized, however, not by argument and discussion, but by the application of real research methods to the problems that are waiting to be solved.

Robert H. Goddard

Clark College,
Worcester, Massachusetts

SCIENTIFIC BOOKS

Studies on the Variation, Distribution, and Evolution of the Genus Partula. The Species Inhabiting Tahiti. By Henry Edward Crampton. 313 pp., 34 plates, 252 tables, 7 text figures. Publication No. 228 of the Carnegie Institution of Washington, January, 1917.

Interest having been diverted from pure science by the war, no adequate review has appeared of this monumental and fundamentally important work which represents the results of four journeys of exploration made by its author in Polynesia; in the course of which more than 75,000 adult snails were collected together with over 7,000 adolescent individuals; more than 200 of the valleys of the Society Islands having been visited for this purpose.

The present volume deals with snails from Tahiti alone, and the thorough, scholarly, and conservative treatment given the subject renders this work of paramount value to all future students of the variations of *Partula*.

Not alone were variations and distribution of the adult snails studied, but the young contained in the brood pouches of the adults were dissected out, thus throwing light upon the fecundity of each variety, and the ratio of elimination of the young before they can reach maturity.

Crampton shows that these snails are not found in the dry low-lands along the shore, nor do they occur in the cold regions of the high peaks of the interior, for a temperature of 55°–60° F., stops their activity. The snails are therefore restricted to the relatively moist deeply wooded troughs of the intermediate regions of the valleys where they are commonly found during the day-time on the undersides of the leaves of the banana, wild plantain, caladium, turmeric, wild ginger and dracæna.

The ridges between valleys are generally dry, and thus the snail population of each valley is more or less isolated. Crampton finds that these snails descend from the trees and bushes and feed during the night, or on moist days, upon decaying vegetation. The young and adolescent being more active in this feeding reaction than are the adults.

It has long been known from Garrett's studies that the Tahitian species of *Partula* like the *Achatinella* of Oahu varied from valley to valley, some forms ranging over a wide area while others are restricted to a single valley, or even to a limited region within a valley.

In general moreover the farther apart two valleys the wider the diversity between their snails, although this is not always the case. Crampton's work has the merit of giving precision to our hitherto more or less vague knowledge of the distribution of the 8 species of *Partula* found in Tahiti. He shows conclusively that great changes have occurred since Garrett studied the snails, in 1861–1884, and that in some cases the species have spread over wider areas, and in the interval have produced some new sub-species or varieties. Thus the fascinating picture of a race in active process of evolution is presented. The details of this process are rendered clear by the excellent photographs of relief maps, and

the numerous diagrams which accompany the text.

In a brief review such as the present it is not possible to do justice even to some of the more important details of Crampton's masterly work, but it is interesting to see that according to Garrett, *Partula clara* was rare and found only in a sector of valleys comprising about 1/4 the area of Tahiti, while Crampton found it to be very common and to range over 4/5 of the whole island, this dispersal having been accomplished by migration from the former restricted habitat of the species. There are now 7 subspecies, and mutation has occurred not only in some of the new valleys the snail has occupied since Garrett's time but also in the area in which it was found by Garrett.

Partula nodosa which in 1861 was confined to Punaruu valley has now migrated into 6 other valleys, and 3 new varieties have arisen in the area into which it has traveled, as Crampton illustrates in his text-figure 6 on page III.

Nearly one half of Crampton's volume is devoted to an analysis of the group species *Partula otaheitana* with its 8 subspecies and varieties of primary, secondary, and tertiary degree, thus constituting the most complex of the known species of *Partula*.

Crampton collected more than 20,000 adult and 6,000 adolescent snails of this form in practically every habitable area of Tahiti.

In Fautaua valley these snails form an extremely complex colony which stands in parental relation to the diverse colonies of other valleys; for in any one of the latter the shells exhibit one combination or another of the so-called unit characters displayed by the Fautaua group as a whole. In this snail Crampton finds some evidence that in the variety *rubescens* red and yellow colorations bear a Mendelian relation to one another, red being dominant. On the other hand in the variety affinis plain color seems to be dominant over the banded pattern in Mendelian inheritance.

Partula hyalina is peculiar in not being confined to Tahiti for it is found also in Mangaia, and Moki of the Cook Group and Rurutu and Tubuai of the Austral Islands, and in marked contrast to this wide dispersal *Partula, filosa,* is found only in Pirai, and *P. producta* in Faarahi valley and have not migrated from these valleys since Garrett's time.

Crampton concludes that in the production of new varieties the originative influence of environment seems to be little or nothing, and isolation is a mere condition and not a factor in the differentiation of new forms. This is in accord with the studies of Bartsch upon *Cerion,* for he found that no new varieties were produced in any of the numerous colonies of Bahama Cerions which he established upon the Florida Keys from Ragged Keys near Miami to Tortugas. When however, these Cerions of Bahaman ancestry crossed with the native Florida from the second generation of the hybrids gave rise to a large number of variations both in form and color.

This observation indicates that similar experiments should be conducted upon *Partula,* for it seems possible that new species may result from the breeding of mutations with the parent stock, or of species with species producing fertile hybrids unlike either of the parent stocks.

The editorial work upon Crampton's volume reflects the greatest credit upon Mr. William Barnum the well known editor of all publications of the Carnegie Institution of Washington. The 15 colored plates lithographed by Hoen are faithful reproductions of the colors and appearance of these snails, and the fact that the book is published upon the best of paper is fortunate for it will be even more interesting to students a hundred years hence than it is at present.

Crampton's work is of such wide interest and importance, and in the light of Bartsch's observations so suggestive of future experimental research that it is hoped these studies may be pursued continuously under the auspices of the Carnegie Institution until final conclusions have been reached through breeding experiments conducted in the field.

A. G. M.

GRAVITY AND AEROSTATIC PRESSURE ON FAST SHIPS AND AIRPLANES

The latest issue of the Meteorological Office Circular, No. 42, December 1, 1919, contains an interesting note on the Behavior of Marine Barometers on board fast ships. The views expressed are based on certain experiments made by Professor Duffield upon the value of gravity at sea. In his work it became necessary to study carefully the variations of pressure recorded by a mercury barometer of the new type under different conditions of ship motion.

It has been suspected for a long time that on fast ships and in strong winds, pressure readings might be considerably influenced by eddy action.

The experiments in this case were carried out on H.M.S. *Plucky,* a destroyer. Steaming at 22 knots against a head wind of about 12 m/s., the barometer showed a fall of 1.2 kilobars compared with the reading when going with the wind. This is an aspiration effect and will vary with the location of the instrument aboard the ship. Three barometers were used and the change in the cabins was only 0.4 kb. The fall is sudden and unless the navigating officer is posted might be taken as an indication of impending change in weather. It is stated that opening or closing doors and ports did not materially affect the readings but this we are disposed to question since it has long been known that very noticeable aerostatic pressure variations occur during high winds on opening or shutting doors and windows. At Blue Hill Observatory using large and sensitive barographs with fast moving record sheets we have obtained variations of from 3 to 5 kbs. The location of the opening determines the character of the change; windward openings cause a rise, leeward ones, a fall.

This brings home the necessity of correcting the records of fast ships and it would be especially interesting if our Hydrographic Office would furnish open scale barographs to fast ships and analyze the variations in aerostatic pressure when such vessels were encountering high winds ahead or astern. If our ships and planes could also carry pressure tube anemometers of the Dines's pattern or the modified form provided for the Navy, records showing to a nicety gustiness and relation of speed to pressure would be available.

The next interesting feature of these experiments is the deduction that a ship moving east and therefore travelling *with* the earth's rotation experiences a consequent increase in the centrifugal tendency, resulting in a slight decrease in the value of gravity as indicated by a mercurial barometer. A west-bound ship, on the other hand, would show an apparent increase. This was put to test on the *Plucky* and it was found that

> on a west course the mercury barometer when compared with an aneroid stood relatively higher than when on an east course, indicating that the mercury weighs less because a longer column is needed to give the same pressure. For a speed of 22 knots the difference amounted to approximately 0.2 kb.
>
> Since bodies travelling east are lighter than when they are travelling west, we expect to find (other things being equal) a west wind above an east wind, a shell fired east with a longer range than when fired west, and an airship going east with a larger carrying capacity than when flying west. H. M. S. *Plucky* weighed about 4 cwt. less on an east course than when steaming west.

Professor Edward V. Huntington in Science, January 9, 1920, p. 45, shows that a body moving westward at high speed requires an increase in the supporting force.

Dr. Carl Herring in the same issue discusses the possibility of moving a mass so rapidly that the net weight would be zero.

Aerographers of course are familiar with the equation on which the above reasoning for gravity rests, namely $2\omega v \cos \phi \sin a$. In this, ω is the angular velocity of the earth's rotation, that is $2\pi/86164$ seconds or .00007292 radians per second; v, the velocity of the ship in meters per second, ϕ, the latitude and α the deviation from true north or south, of the ship's course. Dr. Duffield gives this value for latitude 50° N. as .005 kb. per knot.

Another matter under discussion is the effect of the ship's vibration due to engines upon the sensitiveness of the barograph record. At present it can be said that on a vi-

brating ship the lag of the instrument is much reduced.

All of the above applies with even more force to airships. Deflective influence will modify the course not only in a horizontal but also in a vertical plane. Professor Marvin has shown that when a machine is climbing with given power, the ascent will be more rapid if made clockwise than when counterclockwise; this of course for the northern hemisphere, and conversely in the southern. So the aviator must watch his barometer not less than his compass. With him it is all important that true static pressures be recorded; and at least he should be keenly alive to the importance of the corrections to be applied, most of them functions of speed. When an aneroid is moving at 45 m/s (100 miles an hour) not an unusual speed, he may be called upon to add to or subtract from his proper speed, the air speed, say 25 m/s., also the earths angular velocity.

The exposure of the barograph *is* important. The containing box must have an opening either facing the wind or away from it: if the former, the pressure shown is aerostatic plus aerodynamic. Zahm and others have discussed pressure distribution around a steam-like body and J. G. Coffin has actually designed and used a container that rotates periodically. He found that when the aperture was 45° either side of the head-on position the observed pressure was normal or true static.

From all the above, it is evident that hereafter in the charting and discussion of storm centers at sea, as based on pressure readings, we must know *whether the ships were headed east or west, the angle of inclination of the ship to the wind, the speed of the ship and the speed, direction and gustiness of the wind.*

ALEXANDER MCADIE
BLUE HILL OBSERVATORY,
January 20, 1920

STATE REWARDS FOR MEDICAL DISCOVERIES

A REPORT has been issued by a joint committee of the British Medical Association and of the British Science Guild, which has been considering the question of awards for medical discoveries. According to the abstract in the *Journal* of the American Medical Association the committee defines medical discoveries as being: (1) the ascertainment of new facts or theorems bearing on the human body in health and on the nature, prevention, cure or mitigration of injuries and diseases; (2) the invention of new methods or instruments for the improvement of sanitary, medical and surgical practise, or of scientific and pathologic work. The reasons given for rewarding medical discoveries are the encouragement of medical investigation and the discharge of a moral obligation incurred by the public for its use of private effort. The various public types of rewards are cited as: titles and honors given by the state, by universities and other public bodies; prizes and medals; patents; promotion and appointments; pecuniary rewards by the state. Concerning the general principle of assessment, the committee hold that, in the interests of the public, all medical discoveries should if possible receive some kind of acknowledgment or recompense. But in view of the variable conditions, nature and effects of particular investigations, it will often be difficult to assess the kind of recompense suitable. In the first place, a distinction should be drawn between compensation and reward. By compensation is meant an act of justice done to reimburse losses; by reward an act of grace in appreciation of services. The following different cases should be considered: A. Discoveries involving pecuniary or other loss either by direct monetary sacrifice or by expenditure of time, or by diminution of professional practise, without corresponding pecuniary gains. An example is that of Jenner, who occupied himself so closely with the investigation of vaccination that he lost most of his medical practise and also a considerable sum in expenses. This was fully acknowledge by Parliament, which granted him $150,000. B. Discoveries that have increased the professional emoluments of the investigator by enhanced practise or other means.

Such are frequently improvements in surgical operations or medical treatment, which leads to increased practise. Another case is that of serums, etc., which may have been protected and put on the market. Here compensation can not be demanded, and pecuniary rewards are generally unnecessary. On the other hand, honors are often and justly bestowed for such work. C. Discoveries that involve neither gain nor loss to the investigator. This class includes most of the good and sometimes great clinical, pathologic and sanitary discoveries. Here also compensation can scarcely be demanded, and honors are already often given, but pecuniary awards should sometimes be bestowed as an act of grace when the value of a discovery greatly exceeds the emoluments of the investigator. This principle should hold even for men who are directly paid for undertaking the research, especially when such payment is (as usual) small and the discovery great. Special attention is drawn to: (1) men who have refused lucrative posts to complete researches; (2) men who have refused to protect their work for fear of limiting its application, and (3) men who have carried out investigations for governments for little or no payment, on patriotic grounds.

In the public interest, the committee insists on these principles: (1) No medical discovery should be allowed to entail financial loss on him who has made it. (2) Compensation or reward should be assessed as equal to the difference between the emoluments actually received and those which a successful clinician might have received in the same time. Additional reasons for this are that few medical discoveries are patentable, and they seldom give good grounds for promotion or for administrative appointments in the public services. Whether a particular discovery shall receive large or small assessment will depend, in addition, on these considerations: (1) Width of application. For example, the work of many of the older anatomists, physiologists, and parasitologists, of Pasteur and of investigators of immunity, have affected most recent discoveries. Discoveries on widespread diseases, such as the work of Lister, Laveran or Koch, are often more important that those on more limited maladies. (2) Difficulty of the work done. The solution of a difficult problem requires more study and also more time and cost, and therefore deserves more recompense than a chance observation. (3) Immediate practical utility. A strong plea can be made for state remuneration in cases of this kind unless they come under Class B. Curiously, they never receive it, and academic recognition is also often not forthcoming. (4) Scientific importance. Discoveries not of practical utility may become so at any moment and should be included in the scheme if sound and of wide application.

During the last few years, the British government has disbursed an annual grant of about $300,000, under the Medical Research Committee, for subsidizing investigations authorized by the committee and carried on by workers selected by it. This grant does not remunerate discoveries already made, but proceeds on the principle of payment for prospective benefits.

SPECIAL ARTICLES

A POCONO BRACHIOPOD FAUNA

The Pocono formation of the Appalachian Mississippian measures is known to contain marine fossils in places but little has been published on the subject and the information is scattered and difficult to assemble. The writer has recently found two beds of sandstone in the Pocono Series on Laurel Mountain in Tucker county, West Virginia, which contain branchiopod impressions and has assembled the following list of occurrences of fossils in strata which are considered to be of Pocono age. Since the present note is written in the field, full descriptions of these localities and complete citations to the literature are not given.

POCONO FAUNAL LOCALITIES

1. At Altamont, Maryland, on the western limb of the Georges Creek-Potomac Syn-

cline, noted by G. C. Martin, 1903, Maryland Geological Survey, (Report on) Garrett county, pp. 91 and 92; marine invertebrate fauna noted in the Pocono but not described.

2. In the Broad Top Coal Field of Southern Pennsylvania a Pocono fauna has been collected from a black shale by Messrs. David White and G. H. Girty. They have been studied by Dr. Girty and described in manuscript. The fauna consists of only a few genera and species, only three or four species being found at any single locality. In order of abundance the forms noted were: *Chonetes, Camarotœchia, Rhipidomella, discinoids,* and the pelecypod *Cypricardinia* (oral communication from Dr. Girty).
3. At the Beaverhole (ford and limestone quarries) on Cheat River in Preston county, West Virginia, 8 miles east of Morgantown, brachiopoda were found some years ago by Professor S. B. Brown in a dark shale near the base of the Pocono. A small collection consisting of a very few species of brachiopoda was obtained by the writer several years ago, but no list of the forms is at present available.
4. On Laurel Mountain, in Tucker county, West Virginia, brachiopoda have been found in two sandstone beds lying approximately 30 and 90 feet, respectively, below the top of the Pocono. The lower of the two faunal members rests upon a shale which becomes deep red in color a few feet below its top and seems to be the highest red bed at this point below the top of the Pocono. A small assemblage of forms, which are, however, abundantly represented by individuals, was noted. The upper fauna consists of the following forms as noted in the field, given in the order of relative abundance: *Chonetes, Schizophoria, Spirifer* (coarse-ribbed), a gastropod (*cf. Pleurotomaria*), a pelecypod (*cf. Cypricardinia or Grammysia*). The lower fauna contains the following: *Spirifer* (fine-ribbed), abundant, and *Camarotoechia.*
5. On Limestone Mountain in Tucker county, West Virginia, in talus accumulation from the Pocono were found impressions of *Schizophoria* in sandstone.
6. In the Price (Pocono?) Sandstone of Southwestern Virginia brachiopoda have been collected from at least two localities by G. W. Stose, (oral communication), and their presence noted in Bulletin 530 of the U. S. Geological Survey, p. 251.

The study of the Maryland and West Virginia collections is contemplated by the writer and he would be glad to receive through these columns or otherwise additional information concerning Pocono faunas.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION F—ZOOLOGY

THE Convocation Week meetings of Section F (Zoology) of the American Association for the Advancement of Science were held in conjunction with those of the American Society of Zoologists at Saint Louis, Missouri, December 29, 30 and 31, 1919.

At the business meeting of the section, Professor Caswell Grave was elected secretary pro tem.; Professor George Lefevre, of the University of Missouri, was elected member of the council; Professor B. H. Ransom, of Northwestern University, was chosen member of the general committee; Professor H. B. Ward, of the University of Illinois, was elected member of the sectional committee for five years.

The sectional committee nominated Professor John Sterling Kingsley, of the University of Illinois, as vice-president of the section for the ensuing year.

The address of the retiring vice-president of Section F, Professor William Patten, of Dartmouth College, upon "The message of the biologist" was delivered at the annual dinner of the American Society of Zoologists at Hotel Statler, Wednesday evening, December 31, and is printed in the issue of SCIENCE for January 30.

H. V. NEAL,
Secretary

THE PALEONTOLOGICAL SOCIETY OF AMERICA

The eleventh annual meeting of the Paleontological Society was held at Boston, Mass., in the Rogers Building of the Massachusetts Institute of Technology, December 30 and 31, 1919, in affiliation with the Geological Society of America. The meeting was the best attended in a number of years, and numerous papers on the various branches of paleontology and stratigraphy were presented. An important item on the program was the symposium on the teaching of paleontology which was combined with a similar symposium on the teaching of geology delivered before the joint membership of the Paleontological and Geological Societies. The result of the ballot of officers for 1920 was as follows:

President: F. B. Loomis, Amherst, Massachusetts.

First Vice-president: E. C. Case, Ann Arbor, Michigan.

Second Vice-president: Ralph Arnold, Los Angeles California.

Third Vice-president: E. M. Kindle, Ottawa, Canada.

Secretary: R. S. Bassler, Washington, D. C.

Treasurer: Richard S. Lull, New Haven, Connecticut.

Editor: W. D. Matthew, New York City.

The address of the retiring president, Dr. R. T. Jackson, was on the subject "Studies in variation and a proposed classification of variants."

Following is a list of papers presented.

Recent restorations of fossil invertebrates: John M. Clarke.

The "good use" of the term "fossil": Richard M. Field.

The presence of Upper Silurian sandstone in Essex County, northeastern Massachusetts: A. F. Foerste.

Paleontological collections in the vicinity of Boston: Percy E. Raymond.

The value of Foraminifera in stratigraphic correlation: Joseph A. Cushman.

The intercalation of thecal plates in Holocystites in connection with the criteria upon which species can be distinguished: A. F. Foerste.

A revision of the anticosti section: W. H. Twenhofel.

The hydrozoan affinities of Serpulites Sowerby: W. Armstrong Price.

The Paleozoic section of the lower Mackenzie River valley: E. M. Kindle.

Echinoderms of the Iowa Devonian: A. O. Thomas.

Cambrian formations and faunas of the upper Mississippi valley: E. O. Ulrich.

Bibliographic studies of the Cambrian: Charles E. Resser.

Correlation of the middle Cambrian of Newfoundland and Great Britain: B. F. Howell.

The Trilobites as ancestors: Percy E. Raymond.

The foraminiferal fauna of the Byram Marl: Joseph A. Cushman.

Study of the life processes in fossils: R. S. Bassler.

The method of appearance of additional arms on increasing age in Caryocrinites: A. F. Foerste.

Origin of the "Beach Rock" (Coquina) at Loggerhead Key: Richard M. Field.

Notes on the teaching of paleobotany: Marian D. Martin.

Further discussion of the ecological composition of the Eagle Creek flora: Ralph W. Chaney.

New mounts in the Princeton Geological Museum: Wm. J. Sinclair.

A study of the entelodonts: Edward L. Troxell.

A mounted skeleton of Moschops capensis Broom: William K. Gregory.

Small mammals in the Marsh collection: Edward L. Troxell.

A new method of restoration for fossil vertebrates: Richard S. Lull.

The Oligocene Equidæ in the Marsh collection of Peabody Museum, Yale University: John P. Buwalda.

The Pawnee creek beds of Colorado: F. B. Loomis.

Nothrotherium Shastense, a Pleistocene ground sloth of North America, with remarks on the Megalonychidæ: Chester Stock.

The present status of the Paleocene: W. D. Matthew.

A mounted skeleton of Pteranodon: W. D. Matthew.

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